"Tripod shaped structural element and grid structure obtainable therewith"

* * *

Field of the invention

The present invention relates to a structural element for obtaining three-dimensional constructions.

Summary of the invention

The object of the invention is to make available a structural element having a particularly simple and economical configuration from the constructional point of view, and at the same time capable of being effectively used for the composition of grid structures, also complex ones, both in the field of three-dimensional construction games, and in the civil and industrial field.

An additional object of the invention is to provide a structural element able to be coupled in simple and rapid fashion with similar structural elements to form three-dimensional grid structures with high intrinsic strength.

These and other objects are achieved according to the invention by means of a structural element that is essentially characterised in that it consists of a body in the form of a generally planar tripod, with three equidistant arms whose free ends are arranged to be angularly deviated from a same side relative to the general plane of the tripod body to achieve their union with the free ends of the arms of similar tripod bodies in order to form an approximately spherical grid structure.

As shall become readily apparent, said grid structure is generated by the union of eight of the aforesaid structural elements.

Brief description of the drawings

Additional characteristics shall become readily

apparent from the description that follows with reference to the accompanying drawings, provided purely by way of non limiting example, in which:

Figure 1 is a plan view of a tripod structural element of a first type according to the invention,

Figure 2 is a perspective view of Figure 1,

Figure 3 is a plan view of a tripod structural element of a second type according to the invention,

Figure 4 is a perspective view of Figure 3,

Figure 5 is a perspective view in reduced scale which shows a grid structure formed by the union of eight tripod structural elements according to the invention,

Figure 6 is a lateral elevation view, partial and in enlarged scale, showing a detail of the union between a structural element of the first type (Figures 1 and 2) and a structural element of the second type (Figures 3 and 4) to obtain the grid structure of Figure 5,

Figure 7 shows a tripod structural element of a third type according to the invention,

Figure 8 is a perspective schematic view of a junction element, shown in an open configuration, usable for the mutual union of grid structures according to Figure 5,

Figure 9 is a perspective view of Figure 8, showing the junction element of Figure 8 in a closed condition,

Figures 10 and 11 are perspective and plan views, respectively, showing an alternative embodiment of the tripod structural element according to the invention,

Figures 12 and 13 are perspective and plan views, respectively, showing a further alternative embodiment of the tripod structural element according to the invention,

Figures 14 and 15 are perspective and plan views,

respectively, showing another alternative embodiment of the tripod structural element according to the invention,

Figures 16 and 17 are perspective and plan views, respectively, showing still a further alternative embodiment of the tripod structural element according to the invention,

Figures 18 and 19 are perspective and plan views, respectively, showing a first spacer element employable with the grid structure according to the invention,

Figures 20 and 21 are perspective and plan views, respectively, showing a second spacer element employable with the grid structure according to the invention, and

Figures 22 and 23 are perspective and plan views, respectively, showing a third spacer element employable with the grid structure according to the invention.

Detailed description of the invention

Figures 1, 2 and 3, 4 show the structural element according to the invention respectively of a first and of a second type: as will be shown hereafter, they have such a conformation as to be able to be mutually connected to generate grid structure that is - so to speak - elementary, in turn connectable with identical grid structures to form complex three-dimensional constructions.

The structural element of the first type, globally designated in Figures 1 and 2 with the reference 1, and the structural element of the second type designated in Figure 3 and 4 with the reference 2 have a general configuration that is identical with the exception of the details highlighted farther on.

Each structural element 1,2 consists of a body in the form of a generally planar tripod, having three angularly equidistant arms 1a, 2a which extend from a

central part 1b, 2b. This central part is preferably, but - as will be shown - not necessarily hollow, and the arms 1a, 2a can be at least partially hollow.

Each arm 1a, 2a has a respective free end 1c, 2c, opposite to the central part 1b, 2b, which is arranged to be deviated angularly relative to the general plane of the tripod body.

This angular deviation is made possible by the fact that the free ends 1c, 2c of the arms 1a, 2a are elastically deformable, or rather elastically foldable. This is obtained either simply thanks to the elasticity of the arms or more conveniently, as in the case of illustrated example, thanks to the fact that each free end 1c, 2c is connected to the respective arm 1a, 2a through a narrowed cross section 1d, 2d which defines a folding line. If the structural elements 1 and 2 are to embody a three-dimensional construction game, they will be advantageously formed by moulding of a thermoplastic material: in this case, the narrowed sections 1d, 2d will in practice constitute flexible hinges.

Naturally, the structural elements 1, 2 can be produced with different materials, for example elastomers or thermosetting materials and even metallic materials, such as light alloys, or high strength composite materials, particularly if the structural elements 1 and 2 are destined to build industrial or civil structures (beams, trestles, cranes, floating structures, impact-resistant panels, protective shells, signposts, ladders and mezzanine floors, load-bearing structures for industrial and sporting buildings, roofs for greenhouses and roofs in general, roof elements and composite beams, etc.).

In any case, for the reasons which shall be set out below, the angular deviation of the free ends 1c, 2c of the three arms 1a, 2a of each structural element 1, 2

will be in the same direction, i.e. at the same side relative to the general plane of the tripod body.

The free ends 1c, 2c of the arms 1a, 2a of the structural elements 1, 2 are preferably, but not necessarily, provided with formations for rapid mutual coupling. This arrangement is the chosen one if the structural elements are to constitute components for three-dimensional construction games, whereas as shall be seen it is not normally provided if the structural elements are intended for the construction of civil and industrial structures.

What distinguishes the structural element 1 from the structural element 2 is the conformation of said formations for rapid mutual coupling: in the case of the structural element 1, the formations consist of pairs of contiguous hook-like projections 3, facing the same way relative to the general plane of the tripod structural element 1. In the case of the structural element 2 the free ends 2c are formed with a through opening 4 able to be engaged, by means of a set-in or snap-in coupling, by the hook-like projections 3. In this way, each arm 1a of the structural element 1 can be coupled with an arm 2a of a respective structural element 2, and vice versa. Thanks to the capability for angular deviation of the free ends 1c, 2c, which as stated in the case of the example illustrated in Figures 1, 2 and 3, 4 is made possible by the presence of the flexible hinges 1d and 2d, four structural elements 1 can be joined to four structural elements 2, mutually coupling by means of the respective male and female formations 3, 4. This coupling is exemplified in Figure 6, with reference to one of the arms 1a of a structural element 1 and of the corresponding arm 2a of a contiguous structural element 2.

In this way, as a result of the mutual union

between the eight structural elements 1, 2, an elementary grid structure is obtained, with approximately spherical shape, designated by the reference number 5 in Figure 5. The grid structure thus obtained has twelve mutually equidistant nodal points, corresponding to the coupling areas between the free ends 1c and 2c of the two groups of structural elements 1, 2.

The so-called elementary grid structure 5 can in turn be connected to identical grid structures 5, e.g. with the aid of junction elements, whereof one is designated by the reference number 6 in Figures 8 and 9. This junction element 9, which can also be made of a single piece of moulded plastic material or similar material, consists of two parts 10, 11 mutually articulated in book fashion around a flexible hinge 12 and whereof the first one has a pair of projections with engaging teeth 13 able to be engaged in set-in or snap-in fashion into corresponding hollow recesses 14 of the second part, as a result of their mutual superposition in the manner shown in Figure 9.

In this way, the elementary grid structures 5 obtained as a result of the union of eight structural elements 1, 2 can be mutually composed for the obtainment of complex three-dimensional constructions.

As clarified above, the conformation of the structural elements 1 and 2 described with reference to the example illustrated in Figures 1, 2 and 3, 4 is provided purely by way of example: within the fundamental tripod structure, said structural elements can have different, and possibly also simplified configurations, in particular if they are to be used to build grid structures for civil or industrial constructions, such as those listed above. In this case, each structural element 1, 2 may consist simply

of a tripod body of the type illustrated by the reference number 15 in Figure 7, the free ends 15c of whose arms 15a projecting from the central element 15b may be joined to the free ends of similar elements 15 with traditional mechanical systems such as welding, bolting and the like. In this case too, however, the free ends 15c may be angularly deviated in such a way that the mutual union between the arms 15a of eight structural elements 15 will generate an approximately spherical grid structure similar to the structure 5 of Figure 5, and said grid structures may then be mutually connected (in this case also by means of conventional mechanical junction systems) to obtain complex three-dimensional grid constructions with high intrinsic strength.

Further alternative embodiments of the tripod which can be employed in the grid structure according to the invention are depicted in Figures 10 and 11, 12 and 13, 14 and 15, 16 and 17. These embodiments differ from what has been previously disclosed, and from one another, only in connection with a different constructive arrangement, also as far as the formations for mutual rapid coupling are concerned, in addition to the fact of being provided with a generally non planar but slightly curved or convex configuration, with their central part having a substantially spherical surface. Morever in these alternative embodiments the three arms are connected to the central part having a substantially spherical surface through elastically deformable intermediate sections. This enables an easier composition of the elementary grid structures formed by the mutual connection of the tripods.

Figures 18 and 19, 20 and 21, 22 and 23 show different constructive arrangements of spacer members (respectively a two-way straight configuration, a two-

way angled configuration and a four-way cross configuration) which can be employed to build up complex grid structures deriving by the union of two or more elementary grid structures.

Naturally, the construction details and the embodiments may vary widely from what is described and illustrated herein, without thereby departing from the scope of the present invention as defined in the appended claims.